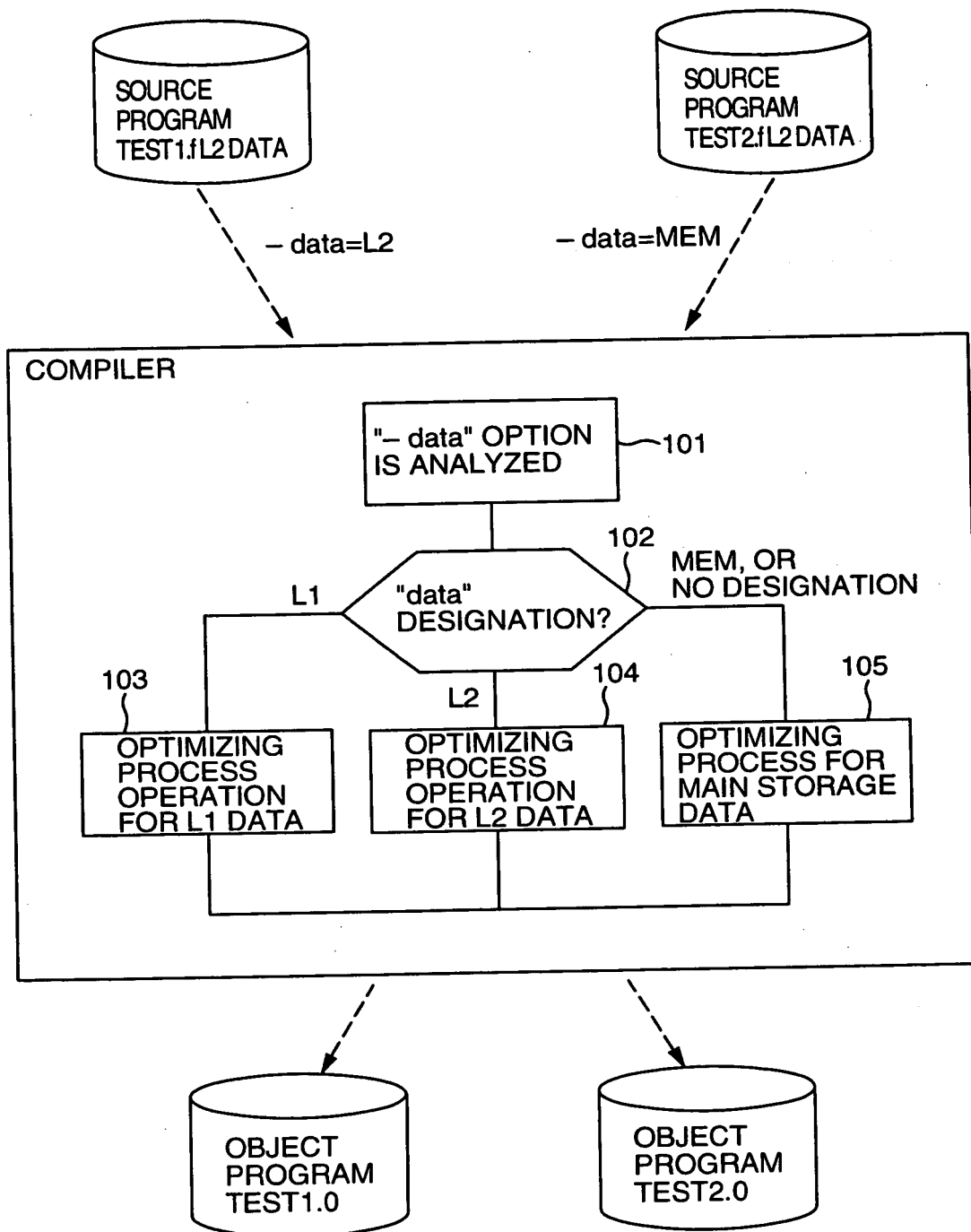Robert C. Colwell, Reg. No. 27,431   (650) 326-2400
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FIG. 1

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FIG. 2

2011   2012   2014   2013

~201

PROCESS UNIT   L1 CACHE   L2 CACHE

BUS INTERFACE

DISPLAY   202

KEYBOARD   203

COMPILER   ~208

INTERMEDIATE CODES   ~209

LOOP TABLE   ~210

MAIN STORAGE

204

SOURCE PROGRAM   206

OBJECT PROGRAM   207

EXTERNAL STORAGE

205

FIG. 3

f90 −0 −data=L2 test . f
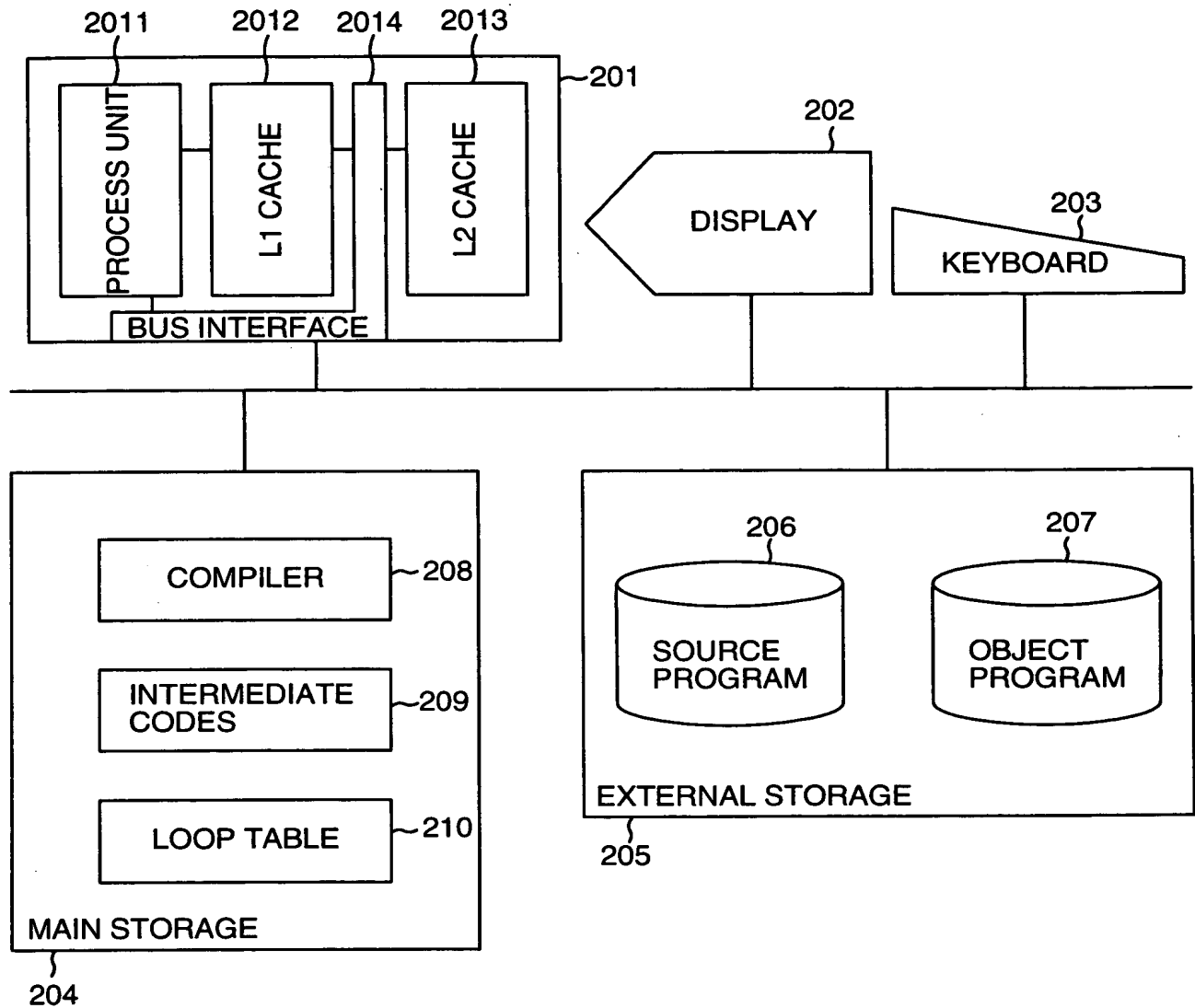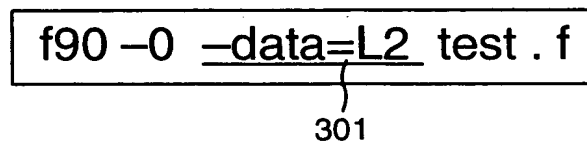
301

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FIG. 4

```
subroutine test1 (A,B,C,D,E,F,N)
real*8 A(N),B(N),C(N),D(N),E(N),F(N)
```

| *option data (L1) | ~401 |

```
do 10 I=1,N
   A(I)=B(I)
10 continue
```

| *option data (MEM) | ~402 |

```
do 20 I=1,N
   C(I)=D(I)
20 continue
```

| *option data (L2) | ~403 |

```
do 30 I=1,N
   E(I)=F(I)
30 continue
end
```

FIG. 6

LOOP NUMBER	"data" DESIGNATION
1	L2
2	MEM
3	NO DESIGNATION
4	L1

601   602

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FIG. 5

START

EXECUTE PARSING ~501

EXECUTE MEMORY OPTIMIZING PROCESS ~502

ALLOCATE REGISTERS ~503

GENERATE CODES ~504

END

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FIG. 7

```
              ┌─────────────┐
             (    START     )
              └──────┬──────┘
                     │
        ┌────────────┴────────────┐
        │        FORM DAG         │──701
        └────────────┬────────────┘
                     │
        ┌────────────┴────────────┐
        │   SET LATENCY TO EDGE   │──702
        └────────────┬────────────┘
                     │
        ┌────────────┴────────────┐
        │ APPLY INSTRUCTION SCHEDULING │──703
        └────────────┬────────────┘
                     │
              ┌──────┴──────┐
             (     END      )
              └─────────────┘
```

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FIG. 8

801

802

LOAD
A (I)

LOAD
B (I)

LATENCY

LATENCY

10

10

803 — mul

LOAD
C (I) — 804

LATENCY

LATENCY

10

10

add — 805

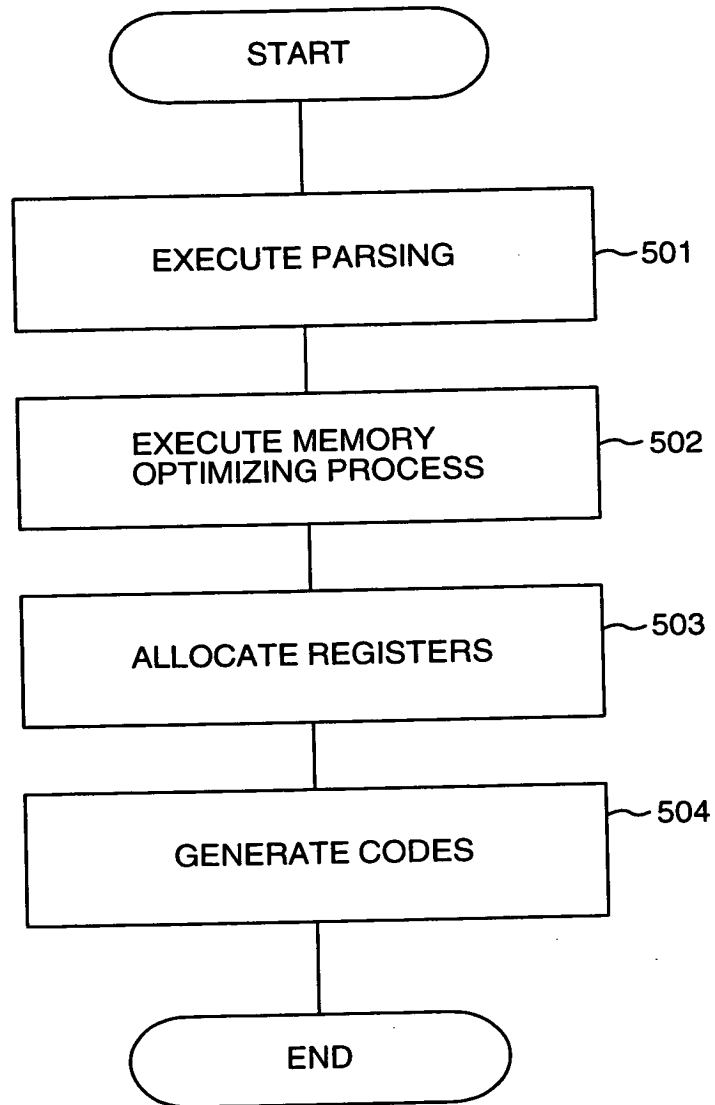Robert C. Colwell, Reg. No. 27,431   (650) 326-2400
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FIG. 9

START

901

UNPROCESSED EDGE IS PRESENT? — NO → END

YES

902

DERIVE EDGE

903

STARTING POINT NODE IS LOAD? — NO →

YES

904

INVESTIGATE "data" DESIGNATION OF BELONGING GROUP

905

"data" DESIGNATION CORRESPONDS TO L1? — YES →

NO

906

"data" DESIGNATION CORRESPONDS TO L2? — YES →

NO

907

SET LATENCY OF MAIN STORAGE ACCESS

908

SET LATENCY OF L2 CACHE

909

SET LATENCY OF L1 CACHE

910

SET LATENCY OF CALCULATION

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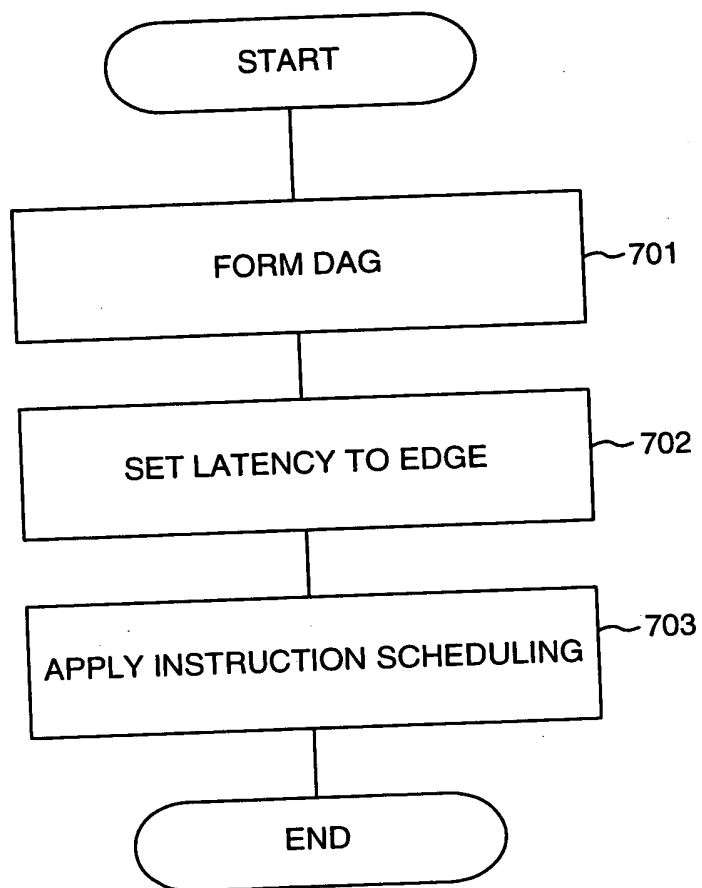Sh et 8 of 11

FIG. 10

START

1001

UNPROCESSED LOOP IS PRESENT? ── NO ──→ END

YES

DERIVE LOOP ～1002

"data" DESIGNATION CORRESPONDS TO L1? ～1003 ── YES ──→

NO

"data" DESIGNATION CORRESPONDS TO L2? ～1004 ── YES ──→ SET L2 CACHE LATENCY TO L ～1006

NO

SET MAIN STORAGE LATENCY TO L ～1005

SET EXECUTION CYCLE PER LOOP ITERATION TO C ～1007

SET CEIL (L/C) TO N ～1008

INSERT PREFETCH CODE AFTER N ITERATIONS INTO LOOP ～1009

FIG. 11

```
                    ┌─────────────┐
                    │    START    │
                    └─────────────┘
                           │
                           │  1101
                    ╱──────────────╲
          NO       ╱  UNPROCESSED   ╲
       ┌──────────│  LOOP IS PRESENT?│
       │           ╲                ╱
       │            ╲──────────────╱
       │                   │ YES
       │           ┌──────────────┐  1102
       │           │ DERIVE LOOP  │
       ▼           └──────────────┘
  ┌─────────┐             │
  │   END   │             │  1103
  └─────────┘      ╱──────────────╲
                  ╱     "data"      ╲
        YES      ╱   DESIGNATION     ╲
     ┌──────────│   CORRESPONDS      │
     │           ╲    TO L1?        ╱
     │            ╲──────────────╱
     │                   │ NO
     │                   │  1104
     │            ╱──────────────╲  YES
     │           ╱     "data"      ╲
     │          ╱   INSTRUCTION     ╲────────────┐
     │         │   CORRESPONDS      │            │
     │          ╲    TO L2?        ╱             │
     │           ╲──────────────╱                │
     │                  │ NO                      │
     │          ┌──────────────┐ 1105   ┌──────────────┐ 1106
     │          │ SET TARGET   │        │ SET TARGET   │
     │          │ CACHE TO L2  │        │ CACHE TO L1  │
     │          └──────────────┘        └──────────────┘
     │                  │                      │
     │                  │◄─────────────────────┘
     │                  │  1107
     │           ╱──────────────╲
     │   NO     ╱    TILING       ╲
     ├─────────│   OPERATION IS    │
     │          ╲   APPLICABLE?   ╱
     │           ╲──────────────╱
     │                  │ YES
     │          ┌──────────────────┐ 1108
     │          │ DETERMINE TILE SIZE│
     │          │ IN CONNECTION WITH │
     │          │ TARGET CACHE       │
     │          └──────────────────┘
     │                  │
     │          ┌──────────────┐ 1109
     │          │ EXECUTE TILING│
     │          │ CONVERTING    │
     │          │ PROCESS       │
     │          └──────────────┘
     │                  │
     └──────────────────┘
```

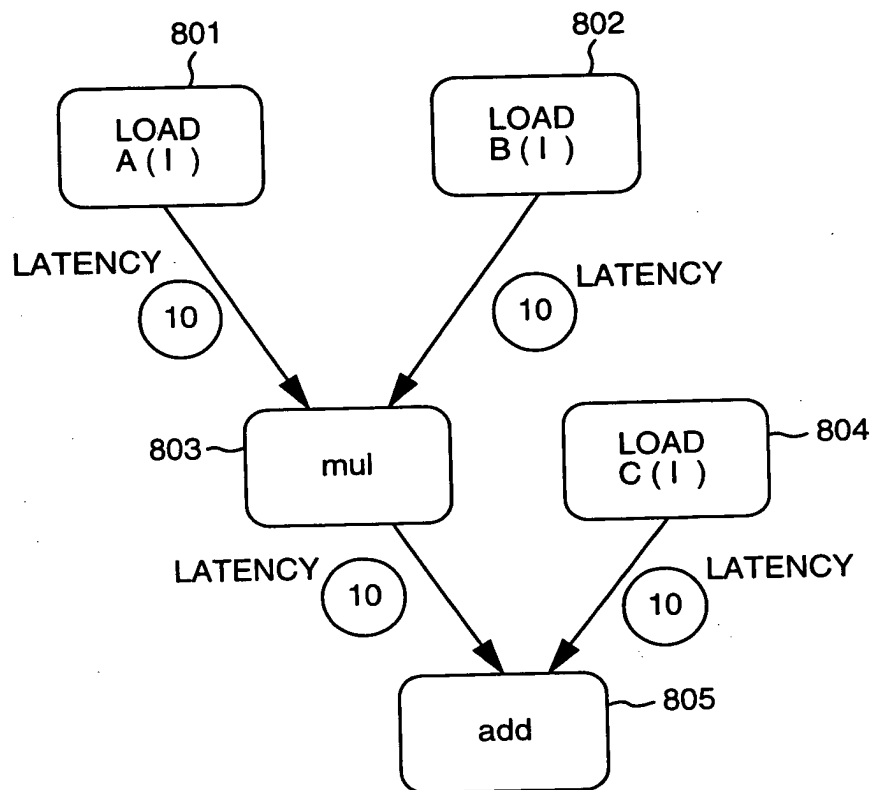Robert C. Colwell, Reg. No. 27,431   (650) 326-2400
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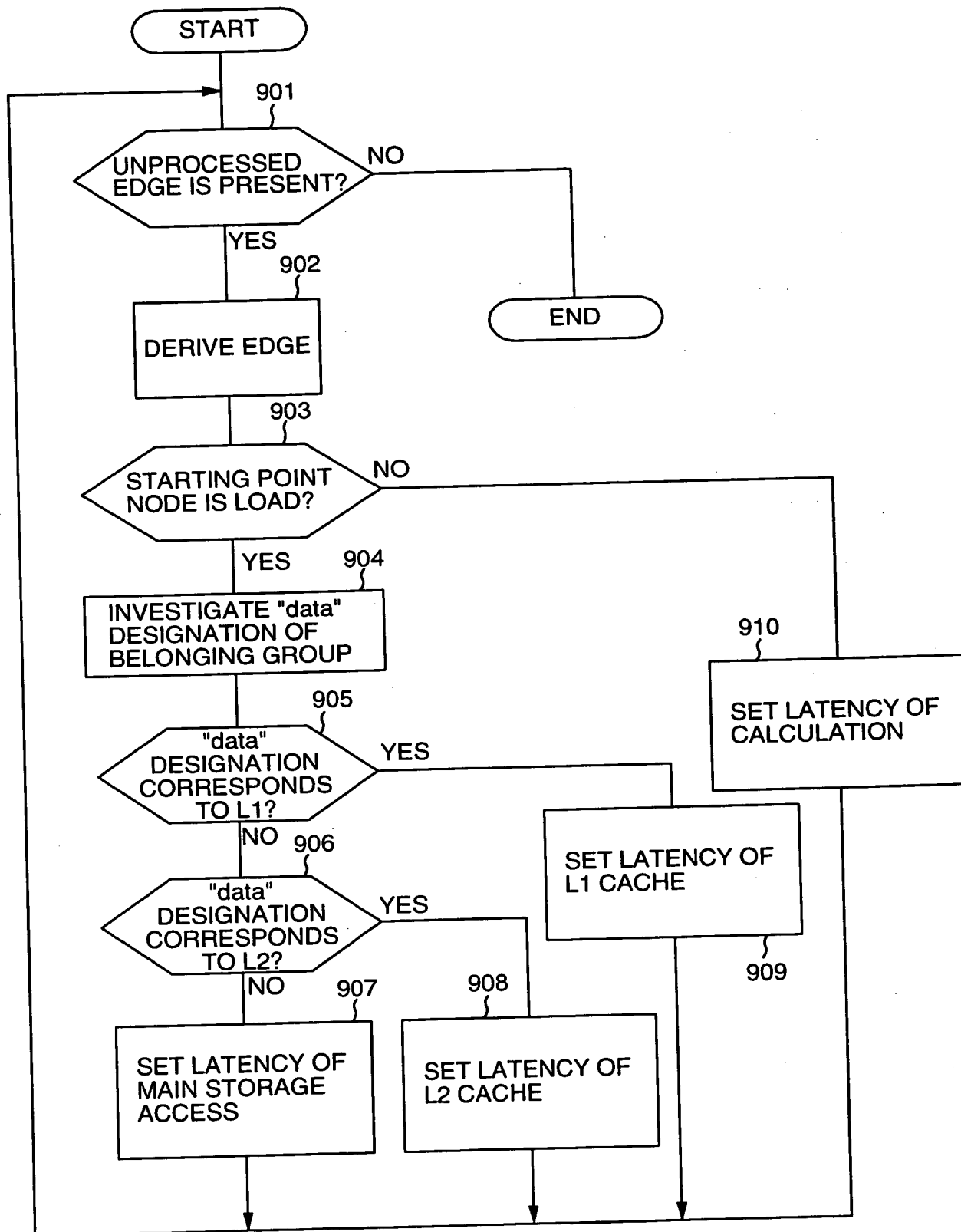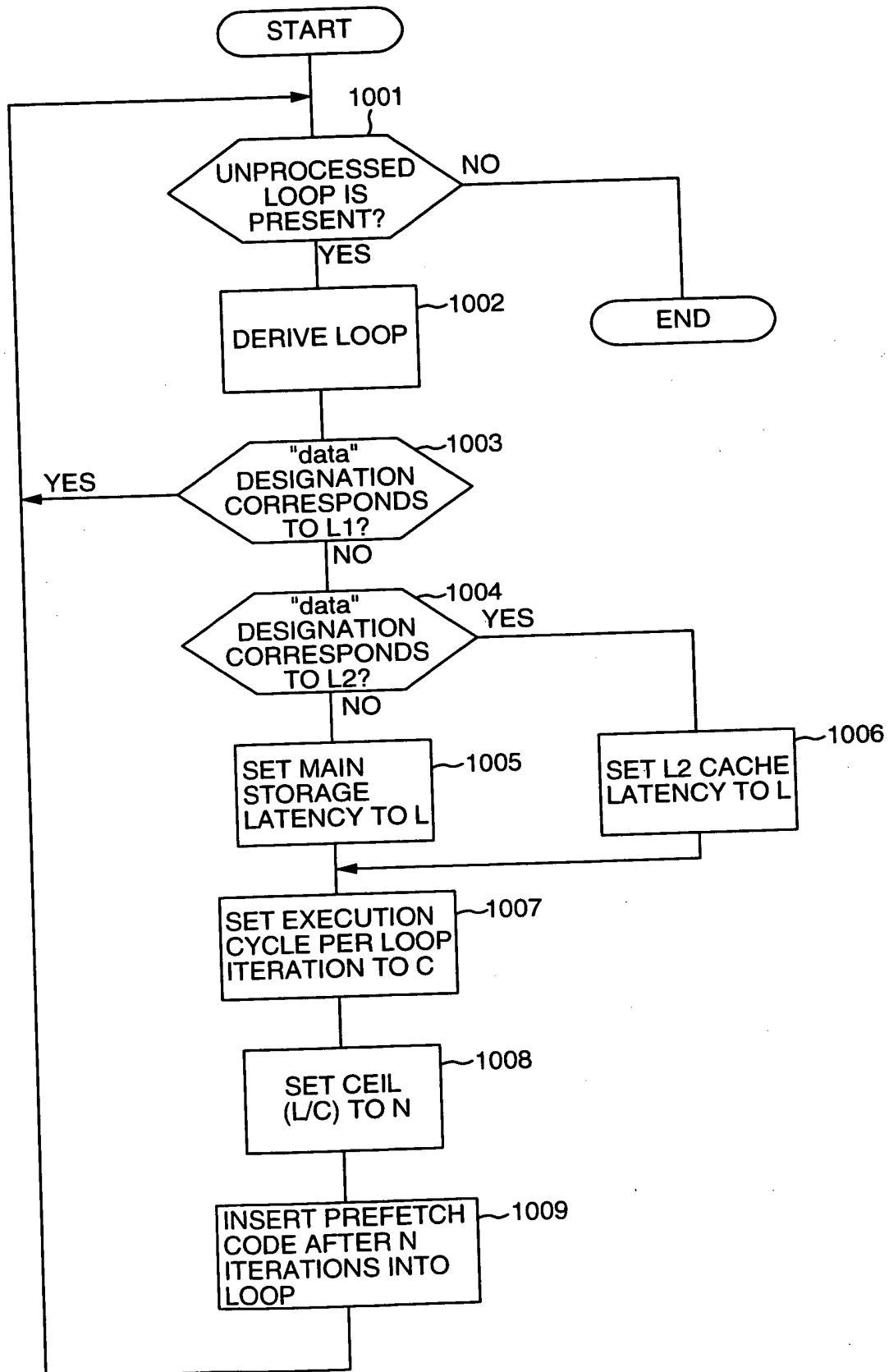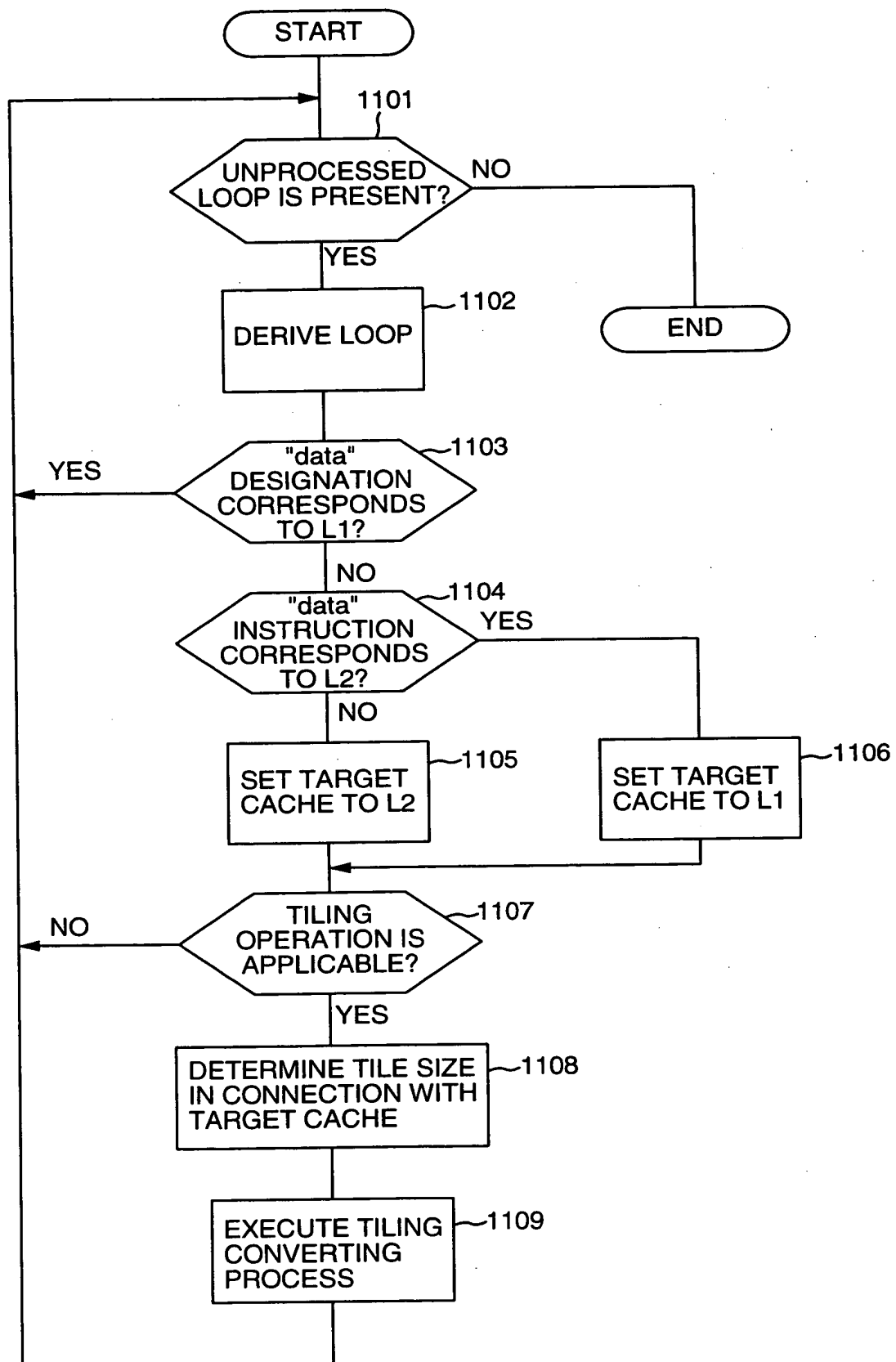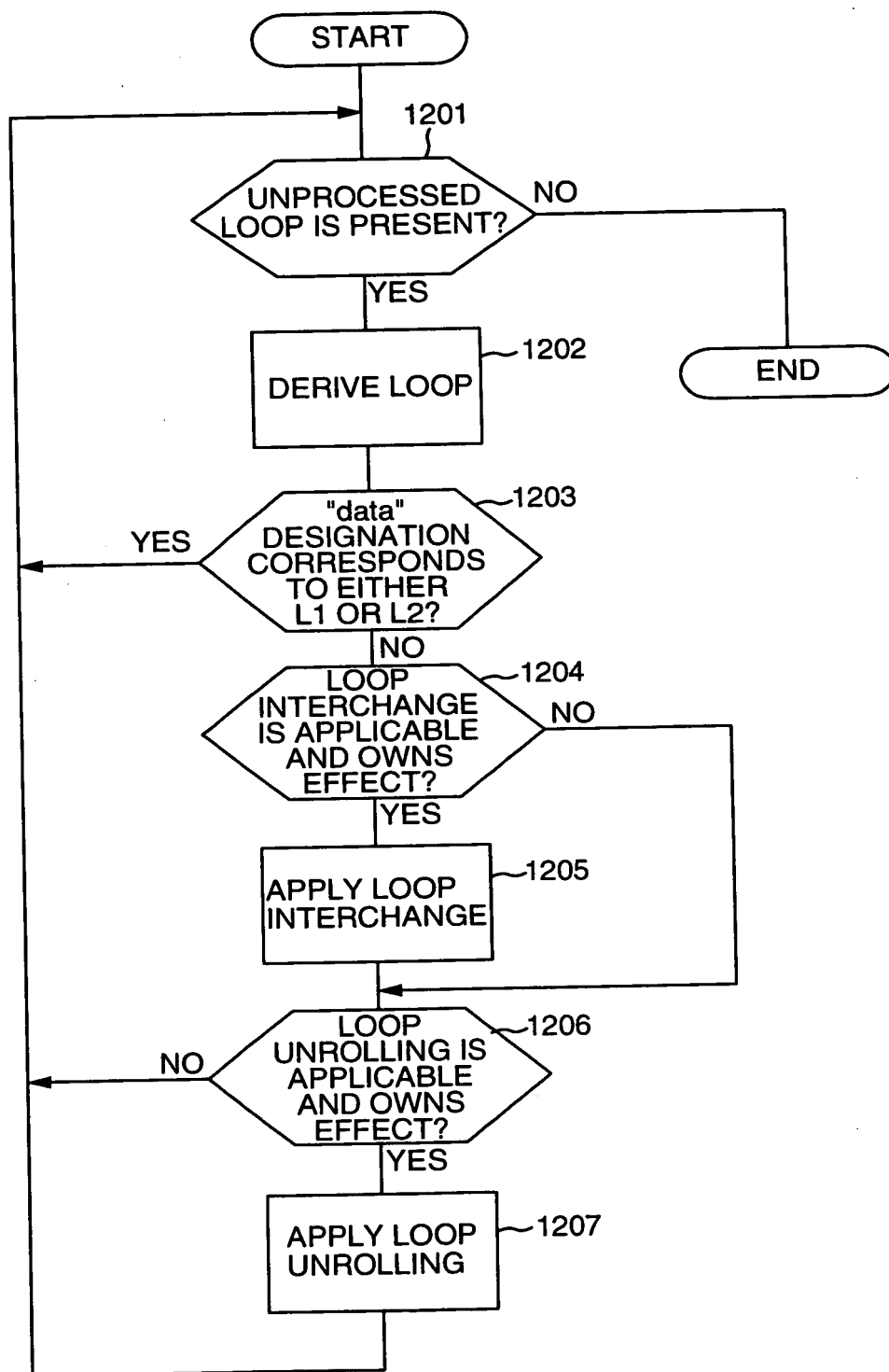Atty Dock t No. 16869S-094900US
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FIG. 12

```
            ┌──────────┐
            │  START   │
            └────┬─────┘
                 │
                 │  ╭1201
        ┌────────┴────────┐
        │   UNPROCESSED    │  NO      ┌──────────┐
        │ LOOP IS PRESENT? ├────────▶ │   END    │
        └────────┬─────────┘          └──────────┘
              YES │
        ┌─────────┴────────┐  ╭1202
        │   DERIVE LOOP    │
        └─────────┬────────┘
                  │  ╭1203
        ┌─────────┴─────────┐
   YES  │      "data"       │
◀───────┤   DESIGNATION     │
        │ CORRESPONDS TO     │
        │  EITHER L1 OR L2? │
        └─────────┬─────────┘
               NO │  ╭1204
        ┌─────────┴─────────┐
        │      LOOP          │  NO
        │  INTERCHANGE       ├──────┐
        │  IS APPLICABLE     │      │
        │  AND OWNS EFFECT?  │      │
        └─────────┬─────────┘      │
               YES │                │
        ┌─────────┴────────┐ ╭1205  │
        │   APPLY LOOP     │        │
        │  INTERCHANGE     │        │
        └─────────┬────────┘        │
                  │◀────────────────┘
                  │  ╭1206
        ┌─────────┴─────────┐
   NO   │      LOOP          │
◀───────┤  UNROLLING IS      │
        │  APPLICABLE        │
        │  AND OWNS EFFECT?  │
        └─────────┬─────────┘
               YES │
        ┌─────────┴────────┐ ╭1207
        │   APPLY LOOP     │
        │   UNROLLING      │
        └──────────────────┘
```

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FIG. 13